First Australian Records of Three Species and Two Genera of Aquatic Oligochaetes (Clitellata: Annelida)

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Recent collections of aquatic oligochaetes in New South Wales and South Australia included three species not previously reported from Australia. These are *Nais barbata* Müller 1774 and *Haemonais waldvogeli* Bretscher, 1900 (Naididae) and *Monopylephorus limosus* (Hatai, 1898) (Tubificidae). The last two of these represent the first Australian records of their genera. Brief descriptions and locality details of Australian specimens are provided.

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KEYWORDS: Naididae, Annelida, *Monopylephorus limosus*, *Haemonais waldvogeli*, *Nais barbata*, Australia.

INTRODUCTION

Although knowledge of the Australian aquatic oligochaete fauna has improved significantly in recent years, there are still large areas of the country (including much of south-eastern Australia) for which few records exist. This paper presents the first Australian records of three species from New South Wales and South Australia. These are the tubificid *Monopylephorus limosus* (Hatai, 1898) and the naidids *Haemonais waldvogeli* Bretscher, 1900 and *Nais barbata* Müller, 1774. Neither the genus *Monopylephorus*, which is represented by several species in the northern hemisphere, nor the monospecific *Haemonais* have been reported from Australia until now. The occurrence of *Nais barbata* brings the number of species of this genus in Australia to six. Almost all of the naidids that occur in Australia are cosmopolitan or at least circumtropical (Pinder 2001) and cosmopolitan species constitute about a third of the Australian tubificid fauna (Pinder and Brinkhurst 2000). The species reported below add to this non-endemic component of these families in Australia.

MATERIALS AND METHODS

Serially sectioned specimens were cut at 6 µm, stained with haematoxylin and eosin and mounted in DePeX. Dissected specimens were stained in Grenacher's Borax Carmine and mounted in Permount. Body measurements are of preserved and slide mounted specimens. Specimens are held by the author (AP colln), returned to the New South Wales Department of Land and Water Conservation (DLWC) in Sydney or the Australian Water Quality Centre (AWQC), Salisbury, South Australia or deposited with the Australian Museum in Sydney (AMS). Collection localities are in New South Wales (NSW) or South Australia (SA).

DESCRIPTIONS AND RECORDS

Tubificidae

Monopylephorus limosus (Hatai)
(Figs 1a, 2)

Synonymy

Vermiculus limosus Hatai, 1898, 103-111, Figs 1-5.

Rhizodrilus limosus (Hatai): Michaelsen, 1900, 41; Yamaguchi, 1953, 297.

Monopylephorus limosus (Hatai): Nomura, 1915, 1, Figs 1-30; Brinkhurst, 1971, 558, Fig. 8.34H.

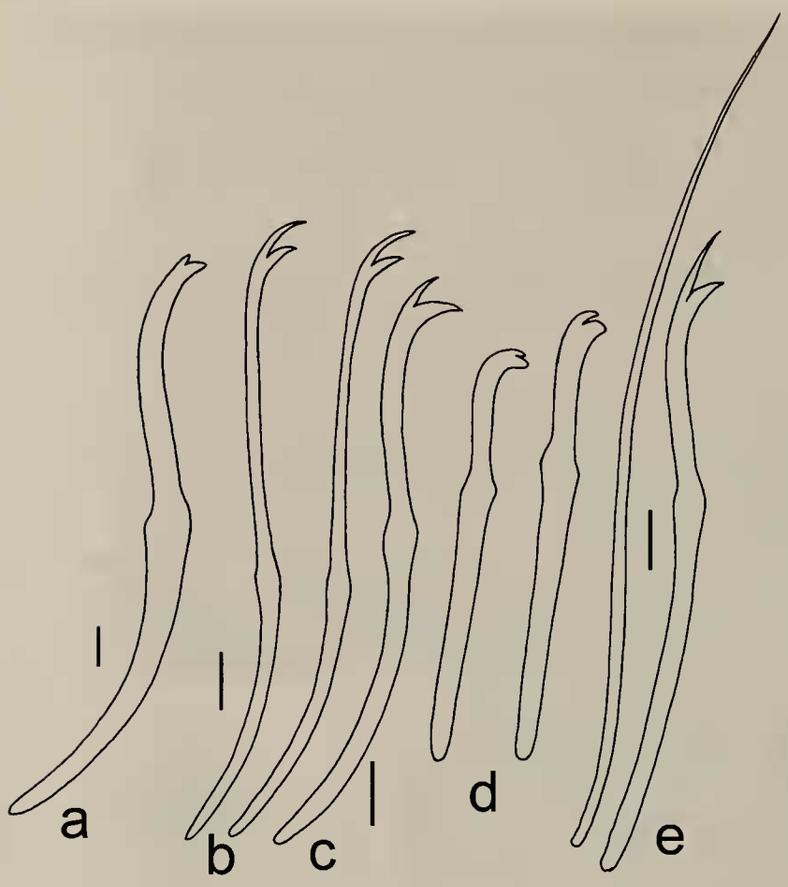

Figure 1. Chaetae of *Monopylephorus limosus* and *Haemonais waldvogeli*. a, bifid chaeta of *M. limosus*. b-f, *H. waldvogeli*: b, two anterior ventral chaetae; c, posterior ventral chaeta; d. penial chaetae; e. a pair of dorsal chaetae (one hair and one bifid chaeta). Scales 10 µm.

Material examined.

Two serially sectioned (AMS W28529 and W28530), 4 dissected (W28528 and AP collection), sludge in pipe from sewage treatment plant to abandoned ocean outfall between North Head (33°48'S 151°18'E) and Malabar (33°57'S 151°15'E) sewage treatment plants, NSW, 1 May 1995. Collection by staff of Sydney Water.

Description of preserved Australian material.

Worms off-white when preserved. Length of body 14 – 26 mm, up to 125 segments. Prostomium rounded conical, anal end bluntly tapered. Coelomocytes abundant throughout body, circular (most 8 – 10 µm) to elongate oval (up to 5 x 15 µm) with large nucleus. Ventral and dorsal chaetae similar in size (125 - 165 µm) and form (all crotchets, hairs absent), starting on II, 4 - 5/bundle in pre-clitellar segments, mostly 3/bundle after clitellum and 2 - 3/ bundle in posterior-most part of body. Chaetae of II and rarely those of other segments simple-pointed, most chaetae bifid with rudimentary upper tooth (Fig. 1a). Chaetae present but not modified on X, absent on XI.

Clitellum indistinct due to pale nature of body, but well developed on entire circumference of X and XI, starting after the spermathecal pores ventrally. Male and spermathecal ducts (Fig. 2a, b) paired but terminating in unpaired spermathecal and male bursae. Testes antero-ventral on IX. Ovaries antero-ventral on X. Male funnels ventro-lateral on 10/11, asymmetrical, usually folded, feeding long ciliated vasa deferentia. Vasa deferentia with 3 parts: a short naked section entally, a much longer and broader (up to 350 µm long and 100 µm wide) middle section covered with diffuse prostate tissue and then a narrow ectal portion without prostates. Vasa deferentia enter protrusible pseudopenes apically. Pseudopenes broad medially, narrower at either end, with thick muscle layers (longitudinal over circular), thin lining tissue and with a broad lumen with cilia on ental two-fifths. Pseudopenes terminating on papillae on lateral walls of voluminous left or right lobes of common median bursa. Bursa muscular, with thin uneven lining tissue, opening to the exterior as a small medial pore on XI half-way between 10/11 and 11/12 beneath ventral nerve cord. Each lobe of bursa with a blind sac entad of the pseudopenis/bursa union. Spermathecal ducts each connected apically to bi-lobed common median bursa. Latter with lobed lining tissue and thick muscle layer leading to a single pore behind 9/10. Spermathecal ducts consisting of an ectal section with narrow lining and thick muscle tissue, a middle section, with thinner muscle tissue and broad, deeply lobed lining tissue and an ental section which has a broad lumen (sperm filled in mated specimens) and thin lining and muscle layers.

Remarks

The terminology used for the male genitalia is based on the revelation (Gustavsson and Erséus 1999) that the ciliated ducts partially covered by prostate tissue are modified vasa deferentia in *Monopylephorus*, rather than atria as previously assumed. The Australian specimens mostly match the descriptions of *M. limosus* provided by Nomura (1915) and Erséus and Paoletti

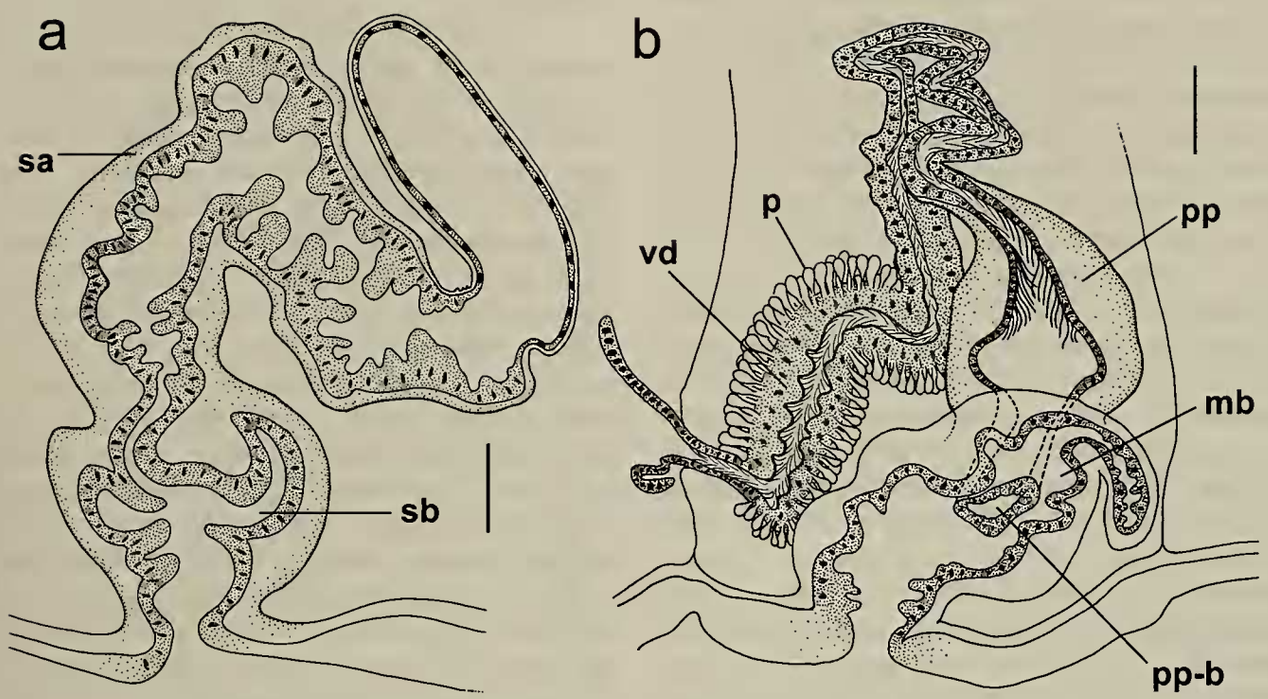

Figure 2. Genital anatomy of *Monopylephorus limosus*. a, spermathecal ducts entering corresponding lobe of median bursa. b, male ducts with pseudopenis shown passing behind (dotted lines) the corresponding lobe of median bursa and entering it laterally. Abbreviations: mb, male bursa; p, prostate; pp, pseudopenis; pp-b, union of pseudopenis with male bursa; sa, spermathecal ampulla; sb, spermathecal bursa; vd, vas deferens. Scale 100 µm.

(1986), which expand on the account of the original Japanese specimens by Hatai (1898). The new specimens differ from previous descriptions in that they have pseudopenes which are ciliated on their ental two-fifths. However, for the present, the Australian specimens are seen as being variants of *M. limosus*. Other *Monopylephorus* species, which are mostly marine, have less complex male bursae (where present at all), and some have eversible rather than protrusible pseudopenes (Baker and Brinkhurst 1981; Brinkhurst and Marchese 1987; Rodriguez 1999). *Monopylephorus limosus* is the only oligochaete known from Australian inland waters that has almost all chaetae bifid with minute upper teeth and with unpaired spermathecal and male pores.

The tolerance of *M. limosus* to a range of salinities and to organic pollution (Chen 1940; Nomura 1915) as well as its apparent introduction to Europe from Asia, suggests this is an opportunistic species (Erséus and Paoletti 1986). It is not clear whether the Australian records are part of a natural distribution, or whether they represent an introduction. In either case, *M. limosus* can be expected to occur at other localities in Australia, at least near coastal population centres but possibly further inland where suitable conditions occur, as in China (Wang Hongzhu pers. comm.). *Embolocephalus yamaguchii* (Brinkhurst 1971), known from Japan and Australia (Pinder and McEvoy 2002), is the only other non-marine tubificid to have an Australasian distribution. Other freshwater species are either cosmopolitan or are known only from Australia (Pinder and Brinkhurst 2000).

Naididae

Haemonais waldvogeli Bretscher

(Figs 1b-e)

Synonymy

Haemonais waldvogeli Brestcher, 1900, 16, Pl. I, Figs 11-14.

Haemonais waldvogeli Brestcher: Sperber, 1948, 154, Fig. 18C; Brinkhurst, 1971, 356, Fig. 7.11M-P.

Haemonais laurentii Stephenson, 1915, 769, Figs 1-5, Pl. LXXIX.

Material examined

Material identified by A. Pinder (on which the following description is based): 1 immature in alcohol (in 2 parts) (AMS W28531), Namoi River at Duncans Junction, 30°18'16"S 149°05'58"E, 30 Mar 2000; 2 immature in alcohol and 2 mature mounted whole on slides (AMS W28532, W28533 and W28534), Macquarie Marsh (North) Third Crossing

Lagoon, 30°44'33"S 147°34'27"E, 12 Apr 2000; Gingham Channel (Gwydir catchment) at Crinolyn, 29°12'37"S 149°08'49"E, 10 Jan 2001; Murrumbidgee River at McKennas Lagoon, 34°25'53"S 145°30'32"E, 8 Feb 2001; 1 immature, Murrumbidgee River at Ganmain Station 1 Storage, 35°00'40"S 147°01'58"E, 22 Nov 2000; Murrumbidgee River at Iris Park Swamp, 35°05'16"S 147°13'30"E, 20 Nov 2000.

Additional material identified by WSL Consultants: Gingham Channel at Rookery, 29°14'51"S 149°19'52"E, 11 Jan 2001; Murrumbidgee River at Coldene Lagoon Storage Gauge, 35°04'26"S 147°45'32"E, 18 Dec 2000;Murrumbidgee River at Ganmain Station 1 Storage, 35°00'40"S 147°01'58"E, 17 Jan 2001; Murrumbidgee River at McKennas Lagoon, 34°25'53"S 145°30'32"E, 29 Nov 2000; Murrumbidgee River at Sunshower Lagoon, 34°36'28"S 146°01'06"E, 27 Nov 2000; Murrumbidgee River at Yarradda Lagoon, 34°35'10"S 145°49'21"E, 28 Nov 2000 and 23 Jan 2001. Collection by Chris Burton, Sean Grimes, Lorraine Hardwick, David Hohnberg, James Maguire, Warwick Mawhinney and Sue Powell (DLWC).

Description of Australian Material

Most specimens incomplete, 2 complete specimens 6.5 mm long, width at VI up to 0.55 mm, number of segments up to 55. Gut containing a variety of diatoms and other algae. Dorsal chaetae (Fig. 1e) starting in XVI to XXI, each bundle with 1 - 2 short (130-150 μm long by 2.5 μm wide), curved hairs with a blunt tip and an equal number of crotchet chaetae. The latter are 100 – 120 μm long by 4.5 – 5 μm wide at the distal (1/3 - 2/5 from the distal end) nodulus with long slightly curved teeth, the upper tooth 1.5 – 2 times longer than the lower. Ventral chaetae all bifid (Fig. 1b-d), normally 3 per bundle (rarely 2), those of first 15 - 19 segments longer, thinner and straighter (105-120 μm long by 3-3.5 μm wide at the nodulus) than those of posterior segments, and with upper teeth slightly longer than the lower. Posterior ventral chaetae 85 – 100 μm long by 4-4.5 μm wide at the nodulus and with upper tooth shorter than the lower. Ventral chaetae with nodulus slightly ental in first few segments, thereafter becoming medial and then slightly ectal. Ventral chaetae of VI (penial chaetae) (Fig. 1d) possibly shorter (laying at awkward angle for measurement) but definitely broader (5-6 μm at the nodulus) than adjacent somatic chaetae with more curved tips and shorter teeth than other ventral chaetae.

Mature specimens too flattened under coverslips to make out much detail of the genitalia, but spermathecae in V and atria in VI, both small and globose with short ducts.

Remarks

The combination of similarly sized dorsal and ventral crotchet chaetae and the position and form of the dorsal chaetae are unique to *Haemonais* and the Australian specimens conform to descriptions of the type and only species, *Haemonais waldvogeli*, given in the literature (e.g. Sperber 1948; Harman and Harrel 1975 and Ohtaka and Nishino 1999). Dorsal chaetae are known to be present in newly developed anterior segments (Sperber 1948) but are gradually shed, so may be found more anteriorly than XVI in some specimens. Outside of Australia, *H. waldvogeli* is widespread, with reports from Europe, Africa, Asia and North and South America. A variant of this species, not recorded from Australia but known from India and North America, lacks teeth on the dorsal crotchet chaetae. *Haemonais waldvogeli* is known from a wide variety of lentic and lotic habitats overseas, particularly where submerged plants are present. Australian specimens have been collected from a variety of wetland habitats, including snags, detritus and from samples taken amongst a wide variety of aquatic plants, including *Azolla*, water ribbon, water hyacinth, *Typha*, water couch and lignum. This species is currently known only from the Murray-Darling catchment of New South Wales, but is probably more widespread, at least in south-eastern Australia.

Nais barbata Müller
(Figs 3a-d)

Synonymy

Nais barbata Müller, 1774, 23.
Nais barbata Müller: Sperber, 1948, 116, Pl. VIII, Fig. 4; Brinkhurst, 1971, 338, Fig. 7.7F-I.
(?) *Opsonais obtusa* Gervais, 1838, 17.
Nais obtusa (Gervais): Michaelsen, 1900, 25.

Material examined

1 immature on slide (AMS W28535), Nattai River at The Crags, NSW, 34°23'21.7"S 150°25'31.6"E, 10 Dec 2001; 2 immature on slide (AMS W28536), Wingecarribee River at Berrima, NSW, 34°29'26.3"S 150°19'57.7"E, 10 Dec 2001; 1 immature in alcohol, Mongarlowe River at Monga Bridge, NSW, 35°32'34.6"S 149°55'47.5"E, 5 Dec 2001; 1 immature in alcohol, Mongarlowe River at Charleyong Bridge, NSW, 35°15'02.8"S 149°55'13.5"E, 5 Dec 2001. 2 immature in alcohol (AP colln), 2 immature in alcohol (AMS W28537) and several returned to AWQC, Murray River at Craignook Landing, SA, 34°53'S 139°39'E, 28 May 2002; 3 immature in alcohol (AMS W28538) and several returned to AWQC, Murray River downstream of Lock

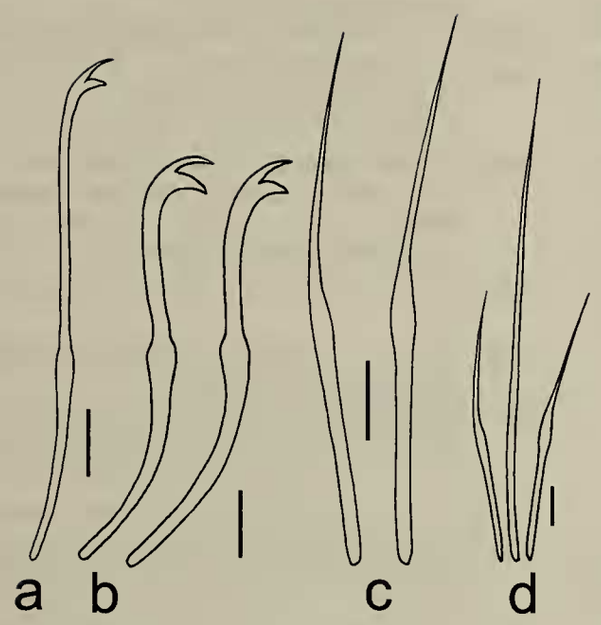

Figure 3. Chaetae of *Nais barbata*. a, ventral chaeta of II; b, ventral chaetae of posterior segment; c, dorsal needle chaetae; d, dorsal needle and hair chaetae. Scales 10 µm.

3, 5km upstream of Overland Corner, 34°11'S 140°21'E, 11 Jun 2002. Collection by Kim Clarke (Ecowise Environmental, Melbourne) or by Vlad Tsymbal, Chris Madden and D. Hicks (AWQC).

Description of Australian Material

Length 1.0 - 2.9 mm long and width at VI 0.15 – 0.2 mm. Gut contents fine detritus and various diatoms. Dorsal chaetae (Fig. 3c, d) from VI, each bundle with 1 - 3 hair chaetae (150 - 200 µm long by 2 µm wide at level of body wall) with an equivalent number of simple-pointed needle chaetae. The latter 58 - 82 um long by 2 µm wide at the slightly distal nodulus, bent slightly at the nodulus, with a parallel sided shaft ental to the nodulus and an ectal end that tapers evenly to a fine point. Ventral chaetae all bifid (Fig. 3a, b), 3 - 4 per bundle, anteriorly with ental nodulus and with upper teeth longer than and slightly thinner than the lower, posteriorly with slightly distal nodulus and teeth about equal in length but the upper slightly thinner. Ventral chaetae of anterior bundles longer and thinner (69 - 78 µm long and 2.5 µm wide at the nodulus) than those of posterior bundles (53 - 74 µm long by 4 µm wide).

Remarks

These specimens match descriptions of *N. barbata* (the type species of *Nais*) provided in the literature (e.g. Sperber 1948). Although these accounts usually state 1-5 hairs and 1-5 crotchet chaetae per dorsal bundle, this refers to ranges for the species and individuals with a maximum of 2 or 3 hairs per bundle and an equivalent number of crotchets (like the Australian specimens) are not uncommon elsewhere (Tarmo Timm, Estonia, pers. comm.). *Nais pseudobtusa* Piguet, 1906 is the only other *Nais* with simple-pointed needles known from Australia (Naidu and Naidu 1980), but in that species the upper teeth of the posterior ventral chaetae are longer than the lower and the nodulus on the needle is located closer to the distal end than in *N. barbata*.

Nais barbata has previously been collected from North America, Europe, the near-east, north-east Asia (Japan and Kamchatka) and northern India (Brinkhurst 1971; Brinkhurst et al. 1990; Liang 1964; Ohtaka and Nishino 1995; Stephenson 1923; Timm 1999). Thus, while other Australian non-endemic naidids are part of more continuous cosmopolitan or circum-tropical distributions, the Australian records of *Nais barbata* are the first for the southern hemisphere and represent more of an outlier. The sites listed above are all from the Murray Darling Basin, ranging from upper tributaries to the main channel of the lower Murray, but the species is likely to be more widespread, at least in the south-east. Specimens from the upper tributaries were collected from fresh, neutral to moderately alkaline waters in riffles and stream edge/backwater samples with sediments dominated by coarse material (gravel to cobble) and often with significant algal growth but no macrophytes. Specimens from the lower Murray were collected from reaches with macrophytes and filamentous algae and fresh moderately alkaline water with high turbidity. Learner et al. (1978) found this species to be most abundant amongst filamentous algae in British streams and noted its abundance in organically polluted European rivers.

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and habitat data were provided by Sarah Rish (DLWC). Specimens of *Nais barbata* and habitat data were collected by Ecowise Environmental for a project managed by the Sydney Catchment Authority and were provided to the author via Phil Mitchell (Water ECOscience, Melbourne), or were collected by AWQC as part of the Murray Darling Basin Commission's Sustainable Rivers Audit Pilot Study, funded through the South Australian Department of Water, Land and Biodiversity Conservation. Gordon Thomson (Murdoch University) sectioned specimens of *M. limosus*. Thanks to Christer Erséus and Wang Hongzhu for up to date information on the distribution of *M. limosus* and to Tarmo Timm and Reinmar Grimm for information on the morphology and distribution of *Nais barbata*.

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